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TECHNICAL MEMORANDUMS

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No. 267

AIR FORCES EXERTED ON STREAMLINED BODIES WITH
ROUND OR SQUARE CROSS-SECTIONS, WHEN PLACED
OBLIQUELY TO THE AIRSTREAM.

By C. Wieselsberger.

From Report II of the Göttingen Aerodynamic Institute.

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the files of the National
Advisory Committee
for Aeronautics
Washington, D. C.

June, 1924.

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TECHNICAL MEMORANDUM NO. 267.

AIR FORCES EXERTED ON STREAMLINED BODIES WITH
ROUND OR SQUARE CROSS-SECTIONS, WHEN PLACED
OBLIQUELY TO THE AIRSTREAM.*

By C. Wieselsberger.

The question of behavior of a streamlined body with round or square cross-sections is of importance in determining the shape to give an airplane fuselage. It is our task here to show how the lift and drag are affected, with the object placed obliquely to the air stream. For this purpose, the lift and drag of a streamlined body with round cross-sections and, likewise, of one with square cross-sections were determined for different positions with reference to the direction of the air flow. The first body (an airship model which had been used in previous experiments) had the shape shown by Fig. 1. The second model was given the same length and volume but a square cross-section at every point. The length of each model was 81 cm (31.9 in.) and the largest cross-section was 136 sq.cm (21.08 sq.in.). The experiments were made in a wind velocity of about 18.5 m (60.7 ft.) per second. The second model was turned in two different ways, first around an axis parallel to one side of the cross-section and then around a diagonal of the cross-section.

* From Report II of the Gottingen Aerodynamic Institute, pp. 68-69.

The results of the experiments are represented in Fig. 3 and Tables I-III by the non-dimensional coefficients C_L and C_D , which refer to the area of the largest cross-section. First it is found that, in the symmetrical position of the model with reference to the air stream, the drag is somewhat less with the round cross-section than with the square one. This fact can be explained by the smaller friction due to the smaller surface of the round model, since, for well-shaped bodies, the frictional drag constitutes a large share of the total drag. When placed obliquely to the air stream, only a small lift is exerted on the round model, while the lift is about four times as great on the square model placed at the same angle. The lift is somewhat further increased by turning the square model about a diagonal of a cross-section, since this presents a larger area to the flow. The drag increase for the oblique position is likewise less for the round body. The irregularities noticeable in the experimental results may be due to small irregularities in the models, but may also be affected by the suspension. All the measured forces were very small, so that the degree of accuracy is less than in the usual experiments.

In general, a streamlined body of round cross-section does not increase the drag so much in turning, as one of square cross-section, but develops a correspondingly smaller lift in oblique positions.

Table I.

Streamlined body with circular cross-section.

$$S = 136 \text{ cm}^2 (21.08 \text{ in.}^2)$$

Angle of attack α	Lift Coefficient C_L	Drag Coefficient C_D
-6°	-0.078	0.049
-3	-0.041	0.045
0	-0.012	0.046
3	0.005	0.049
6	0.032	0.056
9	0.079	0.068
11	0.103	0.083

Table II.

Streamlined body with square cross-section.

$$S = 156 \text{ cm}^2 (21.06 \text{ in.}^2)$$

Angle of attack α	Lift Coefficient C_L	Drag Coefficient C_D
-6°	-0.165	0.079
-3	-0.063	0.063
0	-0.007	0.050
3	0.042	0.058
6	0.145	0.080
9	0.286	0.117
11	0.415	0.161

Table III.

Streamlined body with square cross-section
(placed diagonally).

$$S = 136 \text{ cm}^2 (21.08 \text{ in.}^2)$$

Angle of attack α	Lift Coefficient C_L	Drag Coefficient C_D
-6°	-0.251	0.087
-3	-0.100	0.064
0	-0.018	0.053
3	0.031	0.060
6	0.147	0.079
9	0.344	0.114
11	0.480	0.150

Translated by Dwight M. Miner,
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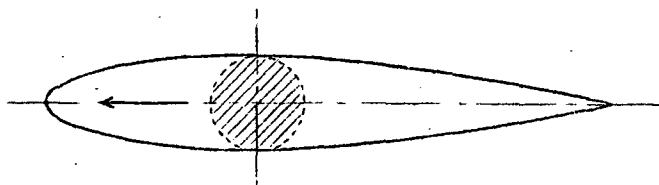


Fig.1.

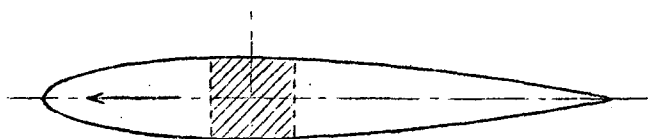


Fig.2.

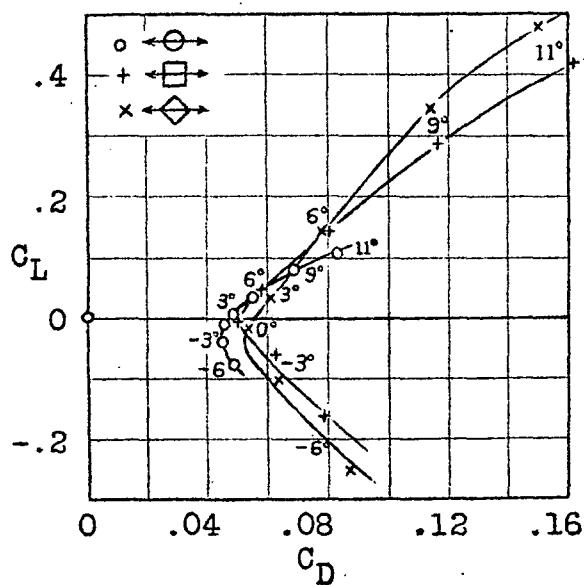


Fig.3.